The Journal

OF THE AMERICAN SOCIETY OF SAFETY ENGINEERS

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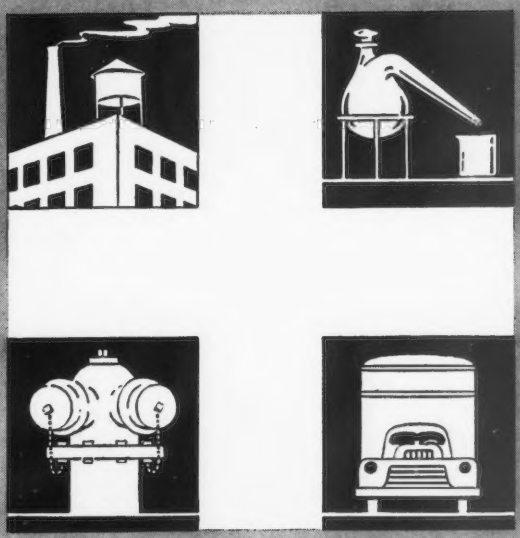

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CURRENTLY the American Society of Safety Engineers has twelve Standing Committees and seven Special Committees on the national level—in addition to countless local committees in the Society's 68 chapters—all working on projects to increase the knowledge and prestige of the safety engineer and advance the safety movement. For those who may wish to communicate with any of the national committees, the names and addresses of the 19 chairmen are published on the inside back cover of this Journal issue . . . One outstanding and timely example of Society committee work is a study of the organizational status of the safety engineer, now being conducted by the national Special Committee on Membership Services. This study has been undertaken to expand and bring up to date a similar Society study made in 1951. Within the next month, every Society member will receive a confidential questionnaire to fill out and return to national headquarters. The results will be published in the Journal as soon as available. We urge all members to cooperate in this project, so highly important to the profession.—Editor

Our President Speaks on SAFETY

OUR nation for many decades has been recognized as a leader in technological advances. As these developments have become integrated into the pattern of American life and, most particularly, American industry, a parallel advancement of safety engineering "know-how" has kept pace, as evidenced by a steady reduction in injury frequency and severity rates over the years.

Today, as perhaps never before in our history, emphasis is being placed on scientific research. Virtually the entire free world is looking to our country to maintain its technological leadership. As a result, new machines and methods are being introduced into industrial operations in unprecedented numbers. For example, X-ray machinery of various types is finding a place in more and more plants; television is beginning to be made use of; isotopes are becoming a part of manufacturing processes; atomic reactors are being developed as power plants. Other technological advances, which may be of even greater impact, are in the immediate offing.

In this rapidly changing situation, and in view of world conditions, the conduct of the safety engineering profession becomes of increasingly acute importance. We are being challenged to keep pace with new developments from the drawing board through the laboratory and other stages so that, as science puts new life into the already lively industrial world, safety engineers will be prepared with practical, effective standards and methods to cover every possible hazard involved.

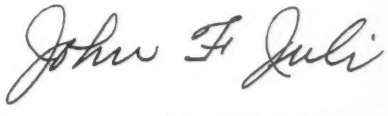
The members of our Society always must be on hand with the necessary technical information. We must learn new techniques to handle new situations and we must increase our efficiency in administering our safety programs authoritatively, with competence and confidence.

When I started to write this article, I did not intend it to be a lecture. However, I cannot conclude without mentioning still another thought. In addition to technical and business "know-how," there are other obligations we all must meet to the fullest possible extent: first, loyalty to our employer, the people with whom we work and the people with whom we associate. The other obligation is one that is so well described by this quotation from a speech of Ned A. Dearborn, president of the National Safety Council:

"The one tremendously important fact about accident prevention work is that it offers one of the best opportunities in our civilization for men and women to apply, in a practical way, the Christian principles of living in a cooperative effort to help each other. I think that this lesson of Christian living is the most important lesson our world has to learn. If we don't learn it, we're going to destroy ourselves."

And I also should like to include another quotation, from Harvey B. Jordan, executive vice president for operations, United States Steel Corporation:

"Gentlemen, the determination to save an injury to ourselves or our fellow empolyes is a Christian thought, and the successful exercise of that determination is a Christian act."



John F. Juli, President
American Society of Safety Engineers

Safety suggestion system aids safety program

Arthur J. Naquin is safety counselor for New Orleans Public Service Inc. with which he has been associated for 32 years. An engineering graduate of Tulane University, Mr. Naquin joined the Society in 1942, is a charter member and past officer of the New Orleans Chapter and past president of the Delta Safety Society. He has taught many college safety courses.

15-year experience of one plant shows correlation of employe participation and injury frequency rates

by Arthur J. Naquin

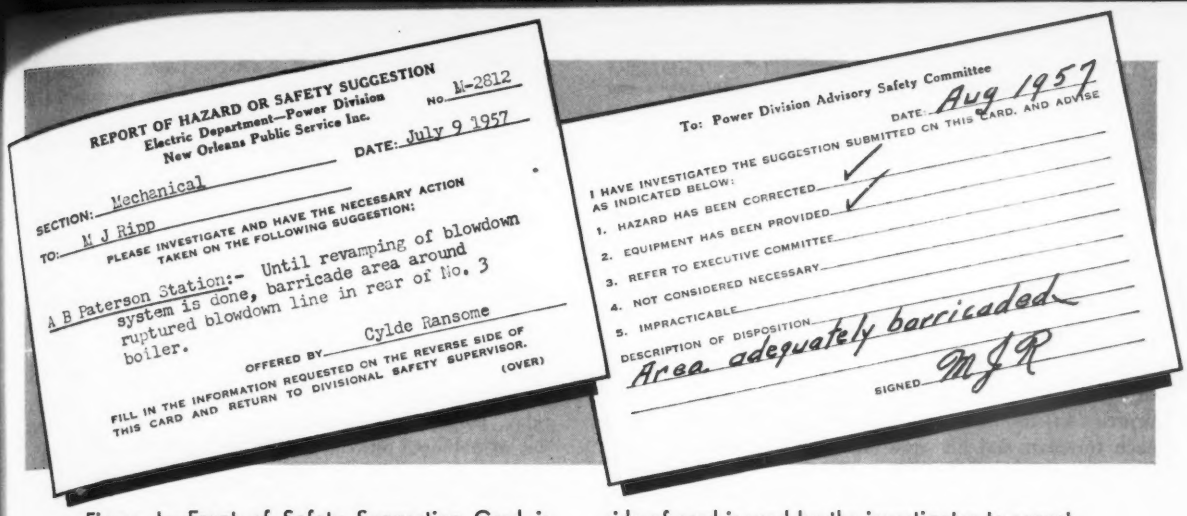
IN 1942, the Power Division of the Electric Department, New Orleans Public Service Inc., expanded its accident prevention program to facilitate and encourage the active participation of every member of the department in safety work. It soon became a routine procedure for each foreman, as he conducted a monthly safety meeting with his personnel, to ask if anyone had any suggestions to offer that would help eliminate potential sources of personal injury.

The same year the safety program was expanded, the division safety supervisor prepared a 3 by 5 inch card form to enable him to handle safety suggestions in an organized way (see Figure 1). The card, which is filled out in duplicate (one copy for the safety supervisor's file), has been designed to refer each new safety suggestion to one or more persons in authority (who previously have agreed at a monthly Safety Advisory Committee meeting to look into the feasibility and worthwhileness of the suggestion). Each safety suggestion, as received, is given a number with the letter prefix "E" or "M" to indicate whether the suggestion has originated in the Electrical or the Mechanical Section of the Power Division.

List Suggestions in Minutes

A list of all pending safety suggestions and all new safety suggestions is carried each month in the minutes of the Safety Advisory Committee of the Power Division. Figure 2 is a reproduction of typical entries in that portion of the minutes which lists all current safety suggestions. It should be noted that the listing includes the name of the person who offered the suggestion, the date on which it was offered, identifying initials of the person or persons who have agreed to investigate it, a description of the suggestion and, ultimately, the disposition made of the suggestion. The methodical way in which this portion of the accident prevention program is administered has won the confidence of all who have participated, for it is true that, once a safety suggestion is offered, it cannot get lost nor will it be forgotten.

Admittedly, this safety suggestion system of the Power Division cuts across an established routine for reporting, on the daily log sheets, matters requiring attention. Nevertheless, the Power Division's general superintendent, from the first, has encouraged general participation



REPORT OF HAZARD OR SAFETY SUGGESTION
Electric Department—Power Division
New Orleans Public Service Inc.
NO. M-2812
DATE: July 9 1957
SECTION: Mechanical
TO: M J Ripp
PLEASE INVESTIGATE AND HAVE THE NECESSARY ACTION TAKEN ON THE FOLLOWING SUGGESTION:
A B Paterson Station:- Until revamping of blowdown system is done, barricade area around ruptured blowdown line in rear of No. 3 boiler.
OFFERED BY Cylde Ransome
FILL IN THE INFORMATION REQUESTED ON THE REVERSE SIDE OF THIS CARD AND RETURN TO DIVISIONAL SAFETY SUPERVISOR.
(OVER)

To: Power Division Advisory Safety Committee
DATE: Aug 1957
I HAVE INVESTIGATED THE SUGGESTION SUBMITTED ON THIS CARD, AND ADVISE AS INDICATED BELOW:
1. HAZARD HAS BEEN CORRECTED ✓
2. EQUIPMENT HAS BEEN PROVIDED ✓
3. REFER TO EXECUTIVE COMMITTEE
4. NOT CONSIDERED NECESSARY
5. IMPRACTICABLE
DESCRIPTION OF DISPOSITION
Area adequately barricaded
SIGNED MJR

Figure 1—Front of Safety Suggestion Card is filled out by safety supervisor to refer employe's suggestion to appropriate investigator. Reverse side of card is used by the investigator to report on disposition of or advise action to be taken on the employe's safety suggestion.

Figure 2—Excerpt from minutes of Safety Advisory Committee meeting shows listing of current safety suggestions.

NO.	By Whom and Date Offered	REFERRED TO	SUGGESTION	DISPOSITION
M-2803	A Anselmo 6/6/57	M J R	A B Pat: Install drain lines at inlet end of No. 4 condenser water box.	Awaiting outage of No. 4 unit.
M-2806	F Zansler 6/11/57	B C C	Market St: Check drainage between boiler room and machine shop.	COMPLETED in August, 1957 —Catch basin installed.
M-2809	E Kimball 7/9/57	S E Jr A H J M J R B C C H N F F J F	A B Pat: Relative to safety suggestions M-2716 and 2717, include procedure for stop tagging manheads on C W tunnels when inspections are made.	COMPLETED in August, 1957 —Tagging of manheads included in committee report in connection with Safety Suggestions Nos. M-2716 and M-2717.
M-2810	E Houin 7/9/57	F J F	A B Pat: Install P A mike in elevators.	Under study.
M-2811	S Belden 7/9/57	S C B	Market St: Change electrical outlets inside of 350 lb. boiler gage board to three prong type.	COMPLETED in August, 1957 —One existing two-prong outlet replaced with three-prong outlet. Other instruments properly grounded.
M-2812	C Ransome 7/9/57	M J R	A B Pat: Until revamping of blowdown system is done, barricade area around ruptured blowdown line in rear of No. 3 boiler.	COMPLETED in August, 1957 —Area has been barricaded.

in the safety suggestion system and ruled that every suggestion offered probably contained some element of injury prevention. Thus, to the writer's knowledge, only one suggestion out of the 4,904 offered, as of the end of 1957, has been discarded as not being a true safety suggestion.

One other point was stressed with the supervisory personnel: the offering of suggestions was not to be considered a reflection on the quality of their supervision or their ability as supervisors. Thus, the matter of searching for and eliminating possible causes of work injuries has become a sincere partnership matter between each foreman and his crew associates.

It would seem natural that, after the first few months or even years, interest in any new phase of an accident prevention program would diminish. Such was the case in the second and third years of the safety suggestion program but, starting in 1945, interest and participation has steadily increased as shown on the accompanying chart (see Figure 3). And the practical quality of the suggestions has not appreciably decreased for, in 1956, 94 per cent of all those offered were approved and ultimately put into effect and, in 1957, 90 per cent have been approved and have been or probably will be adopted. These percentage figures have been very constant ever since 1942.

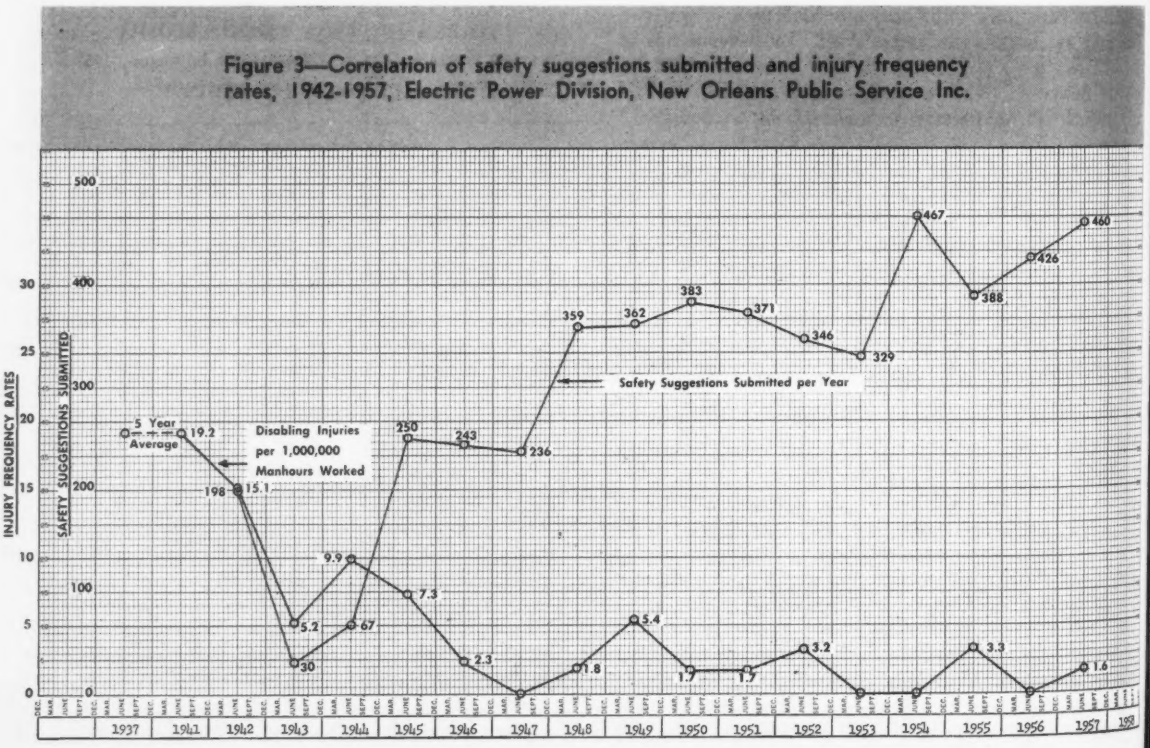
Remaining quite constant also, after 1944, is the average number of suggestions offered per year per member of the Power Division. It has ranged from a low of 1.10 in 1947 to a high of 1.74 in 1954 and has averaged 1.46 for the last 13 years. The figure for the year just past was 1.73. None of these suggestions have been paid for except in appreciative thanks to those offering them as their personal contributions toward making the Power Division a safer place to work.

Many Activities Needed

A well rounded prevention program usually consists of many activities, such as the selection and display of safety posters, showings of slide films, safetygraphs and motion pictures, presentation of demonstrations and lectures, emphasis on good plant housekeeping, consistent use of personal protective equipment, the formulating of safety rules or safe working procedures. Likewise, the offering of safety suggestions fits well into a broad program of injury prevention.

If encouraged, a safety suggestion system can offer tangible evidence of just how well an injury prevention program is understood, accepted and participated in by any given group; just how safety conscious the group is. A high ratio of understanding, acceptance and participation should be reflected in a low injury frequency rate for that group. Such has been the case in NOPSI's Power Division of the Electric Department. Apparently, there has been a correlation year by year between safety suggestion activity and injury frequency rate—not a perfect mirror correlation but something pretty close to it as shown in Figure 3.

Figure 3—Correlation of safety suggestions submitted and injury frequency rates, 1942-1957, Electric Power Division, New Orleans Public Service Inc.



by Fred R. Temple

ACCENTUATE the Positive

Plant Contest Measures SUCCESS of Safety Effort by Placing Emphasis on Self-Improvement

REMEMBER the old song, "Accentuate the positive, eliminate the negative . . ." etc.? Why not try this philosophy in the safety program? We in safety already have found the positive more acceptable and less time consuming, as proved in telling an operator how to do the job right (safely) rather than telling him all the "don'ts" in the safety manual. Desirable responses to positive thinking are greater in number and degree than are responses to the negative.

In the author's experience this positive approach most certainly has worked smoothly and achieved good results in one phase of safety programming: namely, the factory safety contest.

Nearly all plants conduct a safety contest, usually based on the frequency and severity rates. However, many Safety Departments have found that plant safety contests tend to degenerate toward two undesirable extremes:

1. The plant which puts a lot of emphasis on winning winds up with contestants who bicker about responsibility for injury, attempt alibis and may even lose sight of the objective of the contest and the safety program.

2. Where no great emphasis is put on winning, the contestants generally will lose interest and show little enthusiasm when they win.

In either case the tail wags the dog—the safety program promotes the safety contest instead of the contest being an asset to the safety program. Theoretically, the contest should make the overall program better year by year. If your safety contest has a chronic illness, it may need a change of prescription. "Accentuate the positive" may be the tonic that will put new interest and vigor into the contestants. It has paid off for us at Convair Ft. Worth and we think it will pay others, too.

In changing from our former safety contest, based solely on the frequency and severity of injury, we called together five of our superintendents whose interest and judgment we valued most highly. Consensus was that frequency and severity rates merely measured the degree of *failure* of our safety program.

We felt we needed a *better measure of the success* of our safety effort, something that would measure the *positive* things we were doing. In addition, we needed more equitable comparisons, comparing the high hazard departments with other high hazard departments rather than low hazard work with high hazard work. Furthermore, we needed some way of eliminating another situation: departments often had tie scores and we had been declaring the winner to be the department with the greater manhour exposure. In this way some small departments kept perfect scores for months without winning recognition.

To meet these needs, our Safety Engineering Section proposed a new and different contest plan whereby the departments would work against *their own potential maximum score*, not against each other. Our committee of superintendents studied the plan and approved it for use beginning January, 1954.

We have followed this contest plan since. The contestants like it and we like it. We think the departments have developed the right perspective on contests by working to better their previous scores. No department to date has made a perfect score; this is good, too, for the departments thus are provided with a continuing challenge.

The contestants, some 40 departments, have been grouped into five divisions based on similarity of the work. Judging of the contest is based on five items for which contest points are awarded monthly: (1) injury record, including all types of injury, (2) action in correcting hazards reported, (3) quality and number of safety group meetings, both with supervisors and workers, (4) safety and housekeeping inspection score of the department, (5) credit for month free of doctor case and disabling injury.

Each of the five items is explained below:

1. *Injury Record*—200 points maximum score. (A standard of performance, expressed numerically, was set up for each division based on the prior experience of the departments in that division. Because of the way the "standard" number was computed, the higher hazard division has the larger numerical designation.) The department gets 150 points if its current experience, when calculated by the same method as the "performance standard," does not exceed the "standard" number of the division. An improvement in experience, which will result in an "experience" number lower than the "standard" number, is rewarded with an additional five points of contest score for each ten per cent the "experience" number falls below the "standard" number.

Computation of the "experience" number which, like all phases of the scoring plan, is done monthly, can be expressed by the following formula:

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Figure 1 — Monthly computation of Injury Record award points for a theoretical department.

Step I. Determining the "performance standard" number for a division (five comparable departments).

(Note: The "performance standard" number, based on prior experience, is determined before the contest starts and of course is computed only once, not monthly as is the "experience" number.)

Assume:
Division has 500 employes.
Division works 80,000 manhours per month.
For three years immediately preceding first contest year, division averaged (per month) 7.5 first aid cases, 2.5 doctor cases, .67 disabling injuries and 3.33 days lost.

1. Injury computation:

7.5 first aid cases @ 1 unit each	7.5
2.5 doctor cases @ 200 units each	500.
.67 disabling injuries @ 700 units each	469.
total	976.5

$\frac{976.5}{80} = 12.21$ 12.21

(Note: 80 = 80,000 manhours ÷ 1,000)

2. Lost days computation:

Total number of days lost	3.33
Manhours worked	80,000

$\frac{3.33}{8} = .42$ ..... .42

(Note: 8 = 80,000 manhours ÷ 10,000)
Total of (1) 12.21 and (2) .42 ..... 12.63

∴ This is "performance standard" number to be used for all departments within this division.

Step II. Determining the "experience" number for Department X for a given contest month.

Assume:
Department has 100 employes.
Department works 16,000 manhours per month.
For this contest month, department experiences 1 first aid case, 1 doctor case, no disabling injuries and no days lost.

Using formula (given in text of article):

$$E = \frac{1000\ (f + 200\ d + 700\ i) + 10{,}000\ t}{m}$$

$$E = \frac{1000\ (1 + 200 + 0) + 10{,}000\ (0)}{16{,}000}$$

$$E = \frac{201{,}000}{16{,}000}$$

$$E = 12.56$$

∴ This is "experience" number for Department X for the month.

Step III. Comparing "experience" number with "performance standard" number for Injury Record award points.

"Standard" number	12.63
"Experience" number	12.56
	Award Points
Basic points:	
Since "experience" number does not exceed "standard" number	150
Additional points:	
Since "experience" number is lower by only .55 per cent (@ 5 additional points for each 10 per cent lower)	0
Total	150

∴ Department X scores 150 points for the month in the Injury Record category.

ACCENTUATE THE POSITIVE *Continued*

$$E = \frac{1000\ (f + 200\ d + 700\ i) + 10.000\ t}{m}$$

where:
E = "experience" number
f = number of first aid cases[1]
d = number of doctor cases
i = number of injury cases
m = total manhours worked
t = total days lost time

Figure 1 shows the computation for a typical division.

2. *Corrective Action*—Maximum of 100 points. Safety engineer assigned to the department will score the department and affix a rating based on the rating sheet (see Figure 2). Where a safety recommendation is written on repetitive hazards uncorrected, a penalty of 25 points is made.

3. *Safety Committee Meetings and Minutes*—Company policy requires one supervisory safety meeting and two employe safety meetings each month. The following penalties are deducted from a maximum score of 100 points: (a) 25 points penalty for each required meeting not held (total of three meetings a month required), (b) 10 points penalty for each meeting at which the general foreman or superintendent does not preside, (c) 10 points penalty for each meeting for which no minutes are filed with the Safety Engineering Section.

4. *Safety and Housekeeping Inspection*—Maximum of 100 points. Once each month the department is inspected and a rating is given for the safety and housekeeping performance. This rating is interpreted into a percentile score.

5. *Credit for "Accident Free" Months*—Maximum of 100 points. If a department has no doctor case or disabling injury it is credited with 25 points

1. *Our original committee of superintendents was somewhat reluctant to include first aid injuries as part of the tabulation, for fear of keeping workers away from first aid treatment. But they agreed to try it and it has proved to be a successful part of the contest plan.*

for the month. This credit is cumulative; that is, if the department has a second consecutive month free of doctor case or disabling injury, its point credit for this second month is 50. In this way a department may continue to receive more points each month until, at the end of four such months, it is receiving the 100-point maximum every month as long as it remains free of doctor case or disabling injury.[2] Any time such an accident is experienced, the cumulative advantage is voided and the department will receive only 25 points for its next "accident free" month.

It should be noted what recognition is given to the winners in each of the five divisions and for the best performance in the entire plant. There is a small safety banner presented to each division winner on the basis of the high score in the division. The winner having the highest number of award points among the five divisions is awarded the large safety banner for the entire plant.

At first these awards were made each month but for the last two years have been made on a quarterly basis. We find that they have more significance when made quarterly. The plant's manager for operations usually presents the banners. Photographs are made and the presentations are well publicized. So far, in the four years no two departments have made tie scores for the plant banner. Two ties have been experienced in one of the divisions.

Possibly the basis for the contest at first glance seems cumbersome and somewhat complicated but it really is very little more than most plants are doing at present. The necessary information usually is available. This contest plan perhaps makes fuller use of it to stimulate activity.

In conclusion, we believe that our present safety contest comes nearer to measuring the true safety performance instead of merely measuring the failure when injury has been incurred. Accent is now on the "positive" and emphasis is on increasing the assets of a good safety performance.

2. *This schedule was set because our previous experience showed that approximately every four months a department would incur a doctor case, thus eliminating its cumulative credit.*

DEPARTMENTAL CORRECTIVE ACTIVITY	Date_____ Signed_____										
Department #											
Total Score											
RATING OF DEPARTMENT ON:											
Supervisors' general attitude toward accident prevention. (Maximum points 15)											
Alertness in detecting hazardous conditions and work practices. (Maximum points 10)											
Initiative in correction of unsafe conditions and work practices. (Maximum points 10)											
Cooperation in complying with suggestions and recommendations of safety engineer. (Maximum points 10)											
Promotion of safety activities within the department. (Maximum points 10)											
Leadership in setting example for employes. (Maximum points 10)											
Attitude of employes toward accident prevention. (Maximum points 15)											
Absence of recurring unsafe conditions and work practices. (Maximum points 10)											
Readiness to take necessary action to correct violations. (Maximum points 10)											

Figure 2—Rating sheet for scoring departmental performance in taking corrective action on known hazards.

Unprotected steel supports under two tanks failed when exposed to fire, releasing 25,000 gallons of gasoline.

Safe Handling, Use and Storag

by Miles E. Woodworth

NFPA flammable liquids engineer offers authoritative review of hazards and safety measures; directs readers to pertinent literature

WHAT is a flammable liquid? Although definitions vary considerably, most classification systems are based solely on flash point; but the method of test for flash point may vary also. Flash point is the most significant and readily identifiable of the characteristics of a material.

Flash point of a liquid is the temperature at which it gives off vapor sufficient to form an ignitible mixture with the air near the surface of the liquid or within the vessel used. The closed cup flash point. recommended by the National Fire Protection Association. will result generally in a lower figure than the open cup test method. Interstate Commerce Commission regulations call for a

Miles E. Woodworth is flammable liquids field engineer, National Fire Protection Association, and secretary to the NFPA Flammable Liquids Committee which is responsible for 20 technical standards in this field. A graduate of Willamette University, Mr. Woodworth was assistant chief, Portland, Ore., Fire Department before joining NFPA in 1952.

red label on those products which have a flash point below 80° F. by the open cup test method. At this flash point the 80° F. open cup is comparable to the 70° F. closed cup test method.

A good safety man may need also to consider some of the approximately 30 other characteristics of flammable liquids which may affect the safe use of the material. These factors include flammable limits, ignition temperature, vapor density, specific gravity, toxicity under both normal and fire conditions, effect of temperature and pressure, stability or reactivity under conditions of contamination or heat.

Currently there is considerable investigation being conducted on the need for including factors other than flash point—i.e., stability of the product and the health hazard under fire conditions—to assist the user in identifying the hazard of materials. Safety Data Sheets of the Manufacturing Chemists' Association[1] are very valuable in providing authoritative information on a variety of chemicals. As an example of the problem of complete reliance on flash point, a comparison could be made between two identical tanks with one containing gasoline and the other ethylene oxide. The flash point of gasoline is given at —45° F. and for ethylene oxide

...f Flammable Liquids in Industry

at below 0° F. Presuming both of these tanks to be surrounded by fire, what would happen? The gasoline tank, if properly vented, would burn only at the vents. On the other hand, when the vapors of the ethylene oxide in the tank were heated to 1060° F. the vapors in the tank would detonate spontaneously.

The safety and fire protection man of today must consider not only the hazards of a product by itself but also what effect contamination with other products will cause. In one case 10 firemen were killed when a combination of factors caused an uncontrolled chemical reaction to take place which overpressured and ruptured the storage tank.[2] Three were killed by the rupturing of the tank and the other seven by the highly toxic vapors released thereby.

In case of any question on the safe handling of these flammable liquids, the major manufacturing chemical company of the products should be contacted for information on reactivity with other materials or conditions.

Extinguishment

Fire extinguishing is an important factor to be considered in handling any flammable liquids. Of course, the method of extinguishment will vary in proportion to the anticipated size of the fire as well as the type of flammable liquid. Portable extinguishers, hose lines and fixed systems are available for use in extinguishment. In some cases extinguishment may be difficult, if not impossible, to accomplish and, therefore, all that can be done is to prevent the fire from spreading. In general, when flammable liquids are handled indoors, the buildings should be equipped with automatic sprinkler systems.

In a publication entitled "Properties of Flammable Liquids, Gases and Solids" (National Fire Protection Association No. 325), there is available information on the characteristics of materials, including the recommended extinguishing agents for over 650 materials. Another publication of the NFPA which should be of assistance to many safety people is the "Flammable Liquid Trade Name Index" (NFPA No. 325A). This latter publication lists the flash point, principal uses and manufacturers of approximately 3,600 trade name flammable liquid products.

Storage Tanks

After an understanding is gained of the character of any flammable liquid, the first problem is: How should the material be stored? Depending on the quantity needed, the flammable liquids may be stored in tanks located aboveground, underground or in buildings, in drums or in small containers up to five gallons in size.

Vertical aboveground tanks may be cone or dome roofed, a lifter roof, floating roof, sphere, spheroid and variations of these types. The cone roofed tank is the most widely used type of vertical storage tank although the other tanks are becoming more widely used, particularly for vapor conservation purposes.

It is extremely important that standards on tank construction be adhered to faithfully. The American Petroleum Institute, Underwriters' Laboratories Inc. and the NFPA Flammable Liquids Code supply details for con-

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1. *Available from the Manufacturing Chemists' Association, 1625 Eye Street, N. W., Washington 6, D. C.*
2. *The relatively safe product involved was a mixture of ortho dichlorobenzene, propylene dichloride and ethylene dichloride. The aluminum tank in which it was stored previously had been used for storing fatty acid, after which it was steam cleaned. However, the vent unfortunately still was plugged with fat and the fat contained water. It was the mixture of the water with the "safe" product, reacting with the aluminum of the tank, which caused a reaction, thus overpressuring the tank because of the plugged vent.*

struction of various types of tanks. The venting of all tanks, not only for normal breathing but particularly for emergency fire exposure conditions, should be considered in the design. Cone roofed tanks are required to have the seam where the roof joins the shell of the tank designed to fail before the same seam at the bottom of the tank. Such a weakened-seam roof construction allows the roof to fail before the bottom in order to relieve safely pressure generated from an internal explosion or overpressure caused by fire exposure. Vents on all pressure tanks should be directed in a manner which will prevent localized overheating of the tank shell in case there should be a ground fire around the tank which would pressurize the tank and ignite the vent. In a fire in recent years, 18 firemen lost their lives when a pressure type storage tank ruptured violently due to flame impinging on the shell.

Properly designed tanks have an excellent fire record because they resist fire exposure. For example, if the contents of a cone roofed tank are ignited, the shell of the tank above the liquid level folds into the tank (due to softening of the steel caused by the heat of the fire). This action is progressive as the liquid level goes down, and there is no rupture of the shell as some people are inclined to believe.

The contents of a tank are important to consider in evaluating the degree of hazard. With gasoline, for example, the vapor space above the liquid level normally is too rich to burn and, with kerosene or fuel oils, the vapor space is too lean to burn even in the hottest parts of the United States. However, for those liquids whose flash points are in the range of normal summer temperatures. the vapor space above the liquid in the tank normally will contain vapors in the flammable range. On tanks containing these latter-type liquids, flame arresters have their most important application. But condensation, corrosiveness and crystallization of certain products and freezing in winter may make conservation vents, and particularly flame arresters, impractical. Flammable liquids whose flash points are below 70° F. (closed cup test) are required, where practical, to have the tanks equipped either with approved flame arresters or with venting devices which normally shall be closed when not under pressure or vacuum.

Aboveground horizontal tanks should rest on supports of concrete, masonry or steel. Exposed steel supports must be protected by fire resistive materials to provide a fire resistance rating of not less than two hours. The fire record proves the hazards of unprotected steel supports which, unfortunately, are used rather widely. Under fire exposure conditions the unprotected steel supports will fail in approximately five minutes, allowing the tank to drop to the ground. As the tank fails, piping is broken or the tank ruptures, spilling the contents and in some cases resulting in an explosion.

Of concern is the spread of fire to adjacent property or waterways when flammable liquids are stored aboveground. To prevent such fire spread, the most desirable method is to slope or drain the area around tanks to an impounding basin away from the tanks and buildings on adjacent property. If this drainage to a safe location is impractical, then it may be necessary to provide dikes around the tanks. Current NFPA Standards call for the impounding basin or diked area to have a net aggregate capacity of the largest tank and an additional safety factor of ten per cent of the capacity of the remaining tanks involved.

Aboveground tanks should have only steel valves and steel piping. (Cast iron, bronze and brass valves fail under fire exposure, resulting in the release of the tank contents.) The only exceptions are for those flammable liquids which are incompatible with steel, or for certain specific applications. When material other than steel must be used, the user should recognize the possibility of the release of liquid caused by an exposure fire.

Underground flammable liquid tanks are the safest type of storage. Although vent fires occasionally occur, the record would indicate that flame does not propagate into the tank. The vapor pressure of the majority of the products stored, as well as the pipe size of the vent, are probable reasons for this excellent record. However, an increasing problem in the use of underground tanks is their susceptibility to corrosion. Leaks from underground tanks have appeared in basements of buildings more than a mile from the tanks.

Proper installation of the tank—in clean sand or earth—certainly will mitigate the underground tank leakage problem. Care should be exercised to prevent damage to the protective coatings. As a preventive measure, tanks should be air tested before installing them underground and again after the installation is complete. The latter test also should include all piping.

Close inventory control should prevent tank leakages

Burning fuel released from drums of flammable liquids caused severe building damage.

Damage to a large chemical plant was caused by an uncontrolled chemical reaction taking place in a tank car of acrolein. The tank car was located on the tracks immediately in front of the spheres in the center of the picture.

from becoming serious. The possibility of liability to a company which allows ground contamination with flammable liquids certainly indicates the need for top management concern for adequate control and test procedures. Any time a tank is suspected of leaking, it can be tested quite simply. The most widely accepted method is to apply a hydrostatic test utilizing the liquid which the tank normally will hold. Procedures for conducting this type of test are being developed by an NFPA committee and should be available shortly.

Inside buildings, storage tanks of flammable liquids are generally restricted. However, regardless of the type of storage tank or liquid stored, the tanks should be equipped with fill and vent lines which terminate in a safe location outside the building. Supply tanks for oil burning equipment are given separate treatment in "Standards for Oil Burning Equipment" (NFPA No. 31).

Container Storage

The most hazardous type of flammable liquid storage, as the fire record proves, is container storage of flammable liquids. The hazard is not so much in the flammable liquids being the source of ignition, as it is in the containers being exposed to fire which has originated from another source. This exposure to fire causes the containers to overpressure and rupture, releasing the contents. The missile hazard of the ruptured containers, plus the intense heat, prevents effective fire fighting and will overtax all but the best designed of sprinkler systems. Fire tests have proved that volatile flammable liquids in drums should not be stored more than two drums high or, in other containers, should not be stored more than six feet high. This height limitation is based upon storage in buildings equipped with sprinkler systems, or equivalent protection, and the ability of these systems to control fires. In unprotected buildings, storage should be limited to three feet in height or one drum. Flammable liquids in containers should not be stored in the basement of a building, the only exception being for flammable liquids with a flash point above 70° F. in basements protected by automatic sprinkler systems or equivalent. Even liquids with a high flash point, such as lubricating oil, have been the direct cause of an entire building's being destroyed when the containers were exposed to fire.

Containers for flammable liquids must be strong to withstand the rigors of shipping. However, this design strength, necessary to prevent leakage, increases the violence of any container rupture. Also, the possibility of container leakage makes it important to limit the width of a storage pile. Here again, factors of protection and class of liquid affect the storage. In unprotected buildings the width of piles should be limited to four feet for liquids with a flash point under 70° F., with increasing width for less volatile liquids and protected buildings. Additional details of container storage, both inside and outside of buildings, may be found in Chapter III of the NFPA Flammable Liquids Code.

Handling

Certainly the preferred method for handling flammable liquids is in an enclosed piping system. The preferred method for transferring flammable liquids is by means of pumps. However, for some processes gravity feed is necessary and, where used, special precautions should be taken. All piping should be of steel unless the character of the liquid requires other material. In some cases steel pipe is lined with special material to protect the steel against corrosion. Also, the type of pipe used will depend on the pressures necessary. For example, for pressures above 300 psig, only pipe and fittings of ratings specified in American Standards Association Standard B31.1, "Code for Pressure Piping," should be used.

Preferably, tanks and pumps should be outside buildings with the pumps in the open. Similarly, as much of the piping as possible should be outside buildings. Whether the piping is outside or inside a building, it

should be protected against physical damage. In all flammable liquid piping systems consideration must be given, in selecting the type of piping and fittings, to the possible damage which could be caused by fire. In large installations it is common to provide water spray or automatic sprinkler protection for pump houses or pits and for areas of large concentrations of piping. By the same token, sufficient valves—automatic or manual—should be provided to control the flow of liquid for normal operating procedures as well as for emergency conditions.

Piping systems also should be designed to take care of normal expansion and contraction in the systems. Special types of flexible hose connectors are available for use where dangerous stresses may develop in piping due to vibration or where piping is attached to moving equipment.

In handling small quantities of flammable liquids, the use of small containers usually is desirable. Frequently the liquid is stored in drums and dispensed into smaller containers as needed. (Such storage and dispensing should be in rooms cut off from the rest of the building by fire resistive walls. Approved electrical wiring and equipment for Class I Division I Hazardous Locations should be installed. Adequate normal or mechanical ventilation is necessary to prevent accumulations of flammable vapors.) Preferred method for dispensing is by means of a device which draws the liquids from the top of the tank or container. Drum faucets, if used, should be recognized as a potential hazard due to the possibility of leakage. Factory Mutual Laboratories in Norwood, Massachusetts, lists drum faucets and, if such devices are used, only those listed by this or some other nationally recognized laboratory should be used.

For handling of flammable liquids in containers smaller than drums, only approved safety cans of not more than five gallons capacity, having a springclosing lid and cover, should be used. When dispensing from one container to another the operator should have containers connected electrically to prevent static discharge. This connection may be made by means of a bonding wire or by having the container rest on a metallic floor plate which is electrically connected to the fill stem.

It frequently is necessary to store small quantities of flammable liquids in their original sealed containers near the point of use. These small containers will vary in size up to five gallons. For such storage and use, storage cabinets of 50 gallon capacity are available. For those who wish to build their own cabinets, the construction details are given in the NFPA Flammable Liquids Code. Since small quantities of flammable liquids are being widely used in a variety of industries, use of approved safety cans and storage cabinets has become important to the overall safety program. Case histories show that if misused or improperly handled, comparatively small quantities of flammable liquids can be very hazardous.

Use

It is a safety man's responsibility to see that employes using flammable liquids have an understanding of the hazards and a knowledge of proper safety precautions. This employe education plus the rigid enforcement of reasonable company rules governing use of flammable liquids will go a long way toward preventing fires. The safety engineer should study the procedures followed in using a flammable liquid, giving consideration to the characteristics of the liquid. Ventilation should be provided, of course, for volatile liquids where the vapors can spread into the room.

In reviewing the use of flammable liquids in a plant, the safety engineer should study carefully the possibility of using safer liquids. There now are a large number of liquids, specially developed for various purposes.

Uncontrolled chemical reaction resulted in overpressuring the small storage tank of flammable liquids. Ten firemen were killed by toxic vapors and flying fragments of the tank.

which provide far greater safety than materials previously used for similar purposes.

Principal objections to using some of these safer materials, particularly for the cleaning of parts, are that the safer products do not dry rapidly or that they leave a film on the object being cleaned. Liquids used in cleaning, in order to dry rapidly, usually either are highly volatile (low flash point) or are nonflammable but highly toxic. For this reason it is important to educate plant users on the need for using the less volatile but safer materials.

Even with many of these safer solvents there still remains a fire problem. The majority are made with flash points about 100° F. and are reasonably safe for normal usage, for the liquid or the vapors must be heated to flash point before ignition can take place. Even with these higher flash point solvents, however, it is necessary to be alert for potential sources of heat. Unfortunately, some people have the impression that when high flash point solvents are used all hazard is removed.

In one case of fire in a small plant, the owner was very conscious of fire hazards and was a meticulous housekeeper. One afternoon, using five gallons of a solvent with a flash point of approximately 105° F., he cleaned grease and oils from a considerable amount of piping and equipment. This plant was located in the southwestern part of the United States and it was summer. Temperature inside the building was approximately 115°. All the ingredients were there for a fire and apparently a spark from a worn electrical cord provided the source of ignition. The man lost his life and the building was destroyed. Although this plant owner was noted for being fire prevention conscious and for keeping his plant clean, he overlooked one simple fact: *any flammable liquid when heated to its flash point can be ignited almost as easily as gasoline.*

A higher flash point flammable liquid should always be used, if possible, in place of a liquid whose flash point is below normal room temperature. But it is important to remember that, even with the higher flash point materials, not all the hazard is removed.

Another example of recent development of safe liquids for use in place of flammable or combustible liquids is in the field of hydraulic fluids. Many plants have been destroyed when a high pressure hydraulic line has broken, spraying the fluid over the room. Due to the fine misting of the fluid, it is easily ignited, with a resulting serious fire. The new type hydraulic fluid has eliminated this hazard. (With some types of these new so called nonflammable hydraulic fluids it may be necessary to change the type of packing, sealing compounds or paints.)

Special Hazards

In many industrial processes it is necessary to heat a material. Here again the hazards of raising the temperature of a normally safe material to its flash point become of vital concern. In addition, for many of these materials a new factor, ignition temperature, may be brought into consideration. In many processes the materials must be heated above their flash points. Due precautions will prevent a flammable vapor-air mixture from reaching an outside source of ignition. However, if the product is heated higher, to its ignition temperature, the material will ignite spontaneously. Many materials, solids at normal temperatures, become liquid when heated and must be treated accordingly.

Automatic temperature limit controls definitely should be used for flammable liquids. If at all possible, these controls should be set to shut off heat at a temperature below the flash point of the liquid. In other cases where it is imperative to go above the flash point, the controls should be set below the ignition temperature of the liquid. Some liquids, when heated, will detonate or start an uncontrolled chemical reaction before ignition temperature is reached and so controls must of course be set to prevent this reaction. Fail safe controls are preferable, naturally. In many processes requiring temperature limit controls, temperature alarms also are provided to alert plant personnel.

Currently industry is developing many new and improved materials, the manufacture of which often calls for elevated temperatures and pressures. Failure to provide sufficient and adequate controls for many of these processes has resulted in tragic explosions, fires and pressure ruptures. A full discussion of the problem is outside the scope of this article. However, every process calling for elevated temperatures and pressures should be carefully evaluated by the engineering staff of the company. From the many case histories of such fires and explosions it would appear that insufficient thought is being given to the problem. For example, the key lesson to be derived from an analysis of the fire record is what effect the failure of any one control would have on the entire process as well as on other controls.

It is apparent that a fire protection engineer would need to review the above factors very carefully. Also to be remembered is the effect on the characteristics of flammable liquids by these elevated temperatures and pressures. Among other effects, the flammable range of the products will widen. Another important factor to consider is the establishment of safe procedures during start up and shut down of such process equipment. Since the product probably is at its flash point and an ignition source may be present, it will be necessary to eliminate the oxygen, by displacing the air with inert gas, to prevent an explosion or fire. Here again, however, rigid control is necessary to make sure that sufficient inert gas is present in the vessel. And even the lines leading to vessels must be considered. For example, in one case the source of ignition, during the start up of a huge pressure vessel, was in the system leading to the vessel. The resulting pressure wave (pressure pile up) caused a detonation of the 2½-inch steelwalled vessel. Even 4-inch thick steelwalled vessels have been known to fragment under detonation conditions.

Spray Painting

Spray painting basically involves two hazards which must be minimized where spraying operations take place. The first hazard is vapor from the solvent in the paint. In part, the degree of hazard depends on the flash point and quantity of the solvent used. The second hazard is the accumulation of spray residue. The type of paint or lacquer used will determine the degree of hazard and the susceptibility to spontaneous ignition. Both the hazard of solvent vapors and residue from overspray can be controlled by an adequately designed ventilation system.

In addition to the conventional air atomized spray painting there have been increasing use and development of new methods for the application of paint. These methods include spray liquid heaters, high pressure (airless atomization) and electrostatic apparatus. Details of the precautions necessary for each type of spray finishing process can be found in the "Standard for Spray Finishing Using Flammable Materials" (NFPA No. 33).

Where practical, spraying operations should be conducted in properly designed spray booths. Such spray booths have a wide variety of designs for all types of objects to be sprayed. The waterwash type spray booth extracts the spray residue as it passes through a water curtain. Where drying apparatus is permitted to be used in spray booths, special precautions must be observed to prevent any appreciable heating of the surface of the booth. Hot air heating may be particularly hazardous due to increasing the temperature of over-spray residue, resulting in spontaneous heating or ignition. In addition, an interlocked ventilating system is required to ventilate the drying space before the heating system can be started.

Dip Tanks

Dip tanks are used in a wide variety of applications for the purpose of coating, finishing, treating or similar processes. As with spray finishing, adequate precautions must be taken to eliminate as far as possible any accumulations of flammable vapor-air mixtures by providing ventilation. Also, flammable residues present a problem of possible spontaneous heating. Depending on the size of dip tanks, they should be provided with overflow drains or bottom drains and automatic extinguishing systems. Additional details on this type of dipping operation as well as hardening and tempering tanks, flow coat, electrostatic detearing equipment, roll coating and saturation processes can be found in the "Standards for Dip Tanks Containing Flammable or Combustible Liquids" (NFPA No. 34). As the fire record proves, drain boards from dip tanks must be given much the same consideration as dip tanks themselves.

Hot Work on Tanks and Containers

As a representative of one of the largest companies in the United States has stated, the standard most badly needed by industry has been one on how to clean tanks and containers safely prior to performing hot work. After three years of intensive effort by an NFPA committee, such a standard was adopted in May, 1957, entitled "Standard Procedures for Cleaning or Safeguarding Small Tanks and Containers" (NFPA No. 327). One of the first steps before cleaning is to determine what the container previously has held, so as to prevent the possibility of reaction between the product and the cleaner. Prior to performing hot work it may be necessary to clean the container. Cleaning operations preferably should be done in the open. Vapors may be removed by displacement with water, with air or with inert gas. Another method which may be used to safeguard a container is to inert the vapor space to a point where the oxygen content is substantially at zero during the entire time work is in progress. In order to remove residual solids or liquids, steam or chemical cleaning may be necessary.

Regardless of the method used to safeguard a container prior to performing hot work, it is absolutely imperative that tests for flammable vapors be made (1) before commencing alterations or repairs; (2) immediately after starting any welding, cutting or heating operations; (3) frequently during the course of such work. Failure to follow all three of these steps has resulted in numerous explosions and fires, with death and injury to many people. The American Petroleum Institute publishes procedures for safeguarding large tanks, tank cars and tank vehicles.

Conclusions

In summary, flammable liquids can be safely stored, handled and used if the characteristics of the liquids are known and standards of good practice are complied with.

The characteristics of flammable liquids will vary the degree of hazard and must be evaluated for each case.

Storage tanks and piping must be designed and installed in accordance with the latest standards, with consideration for fire conditions as well as for normal operating conditions.

Normal or mechanical ventilation should be provided to prevent the accumulation of vapors when flammable liquids are handled or used in buildings.

Fire control or extinguishing equipment should be provided in buildings handling flammable liquids.

More than 80 flammable liquid storage tanks were destroyed in the largest tank farm fire in the history of the United States. Several of these tanks initially were punctured by flying fragments of steel from an explosion in an adjacent processing unit. Despite lack of adequate dikes, fire did not spread to other property.

how valid are statistics on small business?

by A. M. Baltzer

WITHIN the past year, articles in the Journal of the American Society of Safety Engineers have discussed the validity and reliability of statistics involving small and large plants. The subject is not new; hardly a year in the last 20 has gone by without at least one important article or speech on the subject. Why all the interest in injury rates by size of company? Why all the discussion and the time and space devoted to the pros and cons for alleged inconsistencies in reporting in large vs. small plants?

Perhaps all this talk merely has been an oblique approach to proving the point that injury rates vary inversely to the degree of safety activity. Of course, this rather widely held belief then leads to the conclusion that small firms, which generally have less organized safety activities than large firms, have higher injury rates. But such a conclusion cannot be demonstrated validly due to lack of knowledge on the type of "unit" generally referred to in the size breakdowns. There may be a far more important difference between the type of unit and the degree of safety activity *within* any given size bracket than there is *between* the different size brackets.

At the present time, most statistical breakdowns use the term "unit," an at least implied admission that in the lower employe size brackets—for example, the 50-250 employe bracket—there is a mixture of the following groups:

1. Small, independently owned and operated firms—manufacturing plants, loggers, contractors, warehouses, stores, laundries, auto agencies, etc. This group generally has much less organized safety than the following two groups.
2. Chains—groups of small units, often with negligible safety staff.
3. Branch and main plants of a large corporation—with a varying degree of autonomy or decentralization but perhaps with some guidance or central direction by trained safety engineers, doctors and other specialists. (Many corporations have branch plants or units in *every* size bracket.)

How then can the activity of any group in this 50-250 size bracket be gauged by injury rates when the makeup of this mixture, percentage-wise, is unknown!

The National Safety Council's Small Business Program is primarily concerned with group number one—the small, independently owned firm, particularly in the high hazard industries—because there are so many of these firms which have not yet been reached and helped by safety agencies. Since no safety agency ever can hope to reach adequately and serve directly a majority of these firms, the Council's approach is to use associations, chambers of commerce, local safety councils and other such "multipliers," which routinely contact and work with several million small firms. This program could be advanced by statistics which would give a true picture of safety activity within any size bracket, i.e., by determining accurate rates for each of groups one, two and three, particularly group number one.

The word "plant" also is used too frequently, thereby unintentionally excluding a very high percentage of firms in the non-manufacturing categories of trade, service, construction, sales and other non-agricultural groups. In so doing, attention is diverted from industries which often have higher injury frequency rates than manufacturing. But these non-manufacturing industries include a very high percentage of small, independent employers. So, why not use a general term, "firm" or "employer," which actually is more descriptive of the so called "small business" than the term "plant."

Weaknesses in Original Reporting

Since no agency knows exactly how many independent firms vs. branch plants contribute to rates in various size breakdowns, it is impossible to determine just how many small, independent firms actually contribute figures

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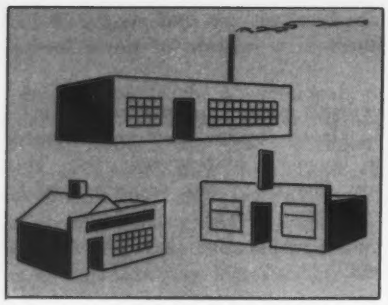
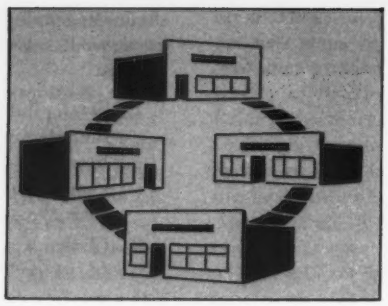


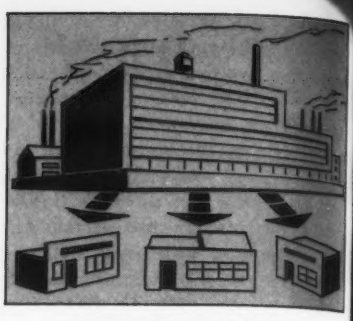
SMALL FIRMS

- Independent plants, stores, etc.
- Owner is "safety man."
- Negligible participation in safety.
- Little, if any, standard reporting.



CHAINS

- All small units, with some degree of central control.
- Perhaps "fair" safety organization.
- Reporting "good" or "fair."



LARGE OR MULTI-PLANT

- Large and small plants.
- Some central control of safety.
- Good participation in safety activities.
- Relatively complete, accurate reporting.

STATISTICS ON SMALL BUSINESS *Continued*

that conform to the American Standards Association's Z16.1. By the process of elimination it would appear that only a very small percentage of small firms do report, and at a uniformly high level of accuracy, for the following reasons:

1. Few statistical agencies require or even encourage standard reporting by a large number of small firms. While more and more insurance companies are stimulating standard reporting, many require figures only on medical and compensation costs (to avoid keeping a double set of records). The same holds true for the state agencies, which usually have better records on compensation cases than on disabling injuries as defined by the ASA Z16.1 Standard.

2. The national agencies depend upon figures voluntarily contributed by industry and, to some extent, those reported by state agencies. The former arrangement requires the cooperation of employers; the response undoubtedly falls off in the category of small, independent firms with little or no knowledge of organized safety or accident reporting. It is estimated that less than five per cent of the more than three million firms in the United States report to any agency. Eliminating the thousands of branch plants and chains leaves an even smaller percentage of small, independent employers to contribute any kind of statistics to state agencies and safety organizations. And it is probable that even those comparatively few small firms that do keep records and report are not typical of the rest.

3. The accuracy of reports varies with the size and type of reporting unit. For example, the companies that report to the National Safety Council generally are the larger firms with professionally trained engineers, statisticians and established reporting systems. The smaller firms, even those that report, usually do not have these advantages and the accuracy of reporting may suffer because the supervisor or employer who makes the report lacks training and experience.

4. There are other complicating factors. Even if a sizable group of small employers understood and remembered the fine points of standard definitions, they still would have to be so completely sold on using the standard method that they would set up the necessary records or train the necessary personnel. If the comparatively small number who got this far were willing and able to report, the time lapse between their disabling injuries would tend to dull their original enthusiasm, and the fine points of reporting would be forgotten. Personnel changes and injuries of a questionable nature and source would further handicap complete and accurate reporting in the smaller firms.

5. Doctors' opinions, which are so important, may not always be completely reliable because many general practitioners, who usually serve small firms, have never heard of Z16.1. Even an industrial clinic, which may be serving a group of smaller firms, may not always apply the definition of "temporary total disability" as correctly as the industrial physician in the large plant. Hence, there very well could be a breakdown of reporting on the part of a doctor who comparatively infrequently has occasion to complete an injury report form.

The purpose of this article is not to detract from the importance of clarifying the Z16.1 Standard. Large numbers of employers, with a tremendous number of employes, *are* keeping records based on the standard; anything that will eliminate confusion and promote better reporting, with less criticism of the other fellow's "laxity," is highly desirable.

However, attention also should be called to greater possible errors arising from too casual use of the term "small plant," particularly when the degree of safety activity is to be gauged by injury rates based upon size of units. Only when the term "plant" or "unit" is carefully defined will there be any significance to such injury frequency rates. Because of these weaknesses in the reporting procedure and because of the mixture of "firms" and "plants" in any given size bracket, the validity of our statistics, particularly on small vs. large units, is open to question.

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Membership Information

THE American Society of Safety Engineers has established the following classifications of active membership.

MEMBER — To be eligible as a Member an applicant shall be at least thirty years of age and shall be engaged in safety engineering. In addition, he shall have either an engineering or science degree in an accredited college curriculum and the equivalent of eight full years' experience in safety engineering; or he shall have had the equivalent of ten full years' experience in safety engineering.

ASSOCIATE MEMBER — To be eligible as an Associate Member an applicant shall be at least twenty-five years of age and shall be engaged in safety engineering. In addition, he shall have either an engineering or science degree in an accredited college curriculum and the equivalent of three full years' experience in safety engineering; or he shall have the equivalent of five full years' experience in safety engineering; or he shall have either an engineering or science degree in an accredited college curriculum, ten years' experience in professional engineering work and one full year's experience in safety engineering; or he shall have twenty years' experience in engineering work, of which at least ten have been at the professional level, and one full year's experience in safety engineering.

JUNIOR MEMBER — To be eligible as a Junior Member an applicant shall be at least twenty years of age and shall be engaged in safety engineering work, which if pursued the required time will tend to qualify the applicant for the classification of Associate Member. In addition, he shall have either an engineering or science degree in an accredited college curriculum or he shall have had the equivalent of one full year's experience in safety engineering.

AFFILIATE MEMBER — The Society also provides a special classification, that of Affiliate Member, for those not professionally engaged in safety engineering. To be eligible as an Affiliate Member an applicant shall be at least twenty-five years of age and shall have contributed to the advancement of safety engineering through demonstrated achievement in some related field of interest in which he has been engaged for at least three years.

for additional information write to

The American Society of Safety Engineers
425 North Michigan Avenue
Chicago 11, Illinois
(or contact your local chapter)

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